WIDER Working Paper 2017/193

# Quantifying the impacts of expanding social protection on efficiency and equity

Evidence from a behavioural microsimulation model for Ghana

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November 2017

United Nations University World Institute for Development Economics Research

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**Abstract:** A large informal sector is a challenge for developing countries building up social protection systems. Expanding social safety nets reduces poverty, but financing them can increase the tax burden, potentially reducing availability of formal sector jobs. This paper quantifies impacts on income distribution and efficiency of expanding developing countries' social protection. Results from a new tax-benefit microsimulation model for Ghana are combined with the extensive margin elasticity of the share of formal work with respect to the tax wedge on formal labour. Estimated formality elasticity is modest but statistically significant; therefore the distributional gains of expanding cash-transfer programmes are considerable, even taking into account behavioural impacts.

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# 1 Introduction

Developing countries, including in Africa, already have some nascent social protection programmes, but they are still at an early stage and the coverage is limited. Many of these countries are in the process of scaling up the programmes and planning social protection systems, as opposed to isolated programmes. If one takes seriously the first of the new Sustainable Development Goals ('Ending poverty in all its forms'), and the fact that not all households can have members who actively participate in income-earning activities, at least some level of social protection should be deemed necessary. In developed countries, the system-wide impacts of social protection policies are often examined ex ante using tax-benefit microsimulation models, but few developing countries have had access to such models.

However, the financing of these social programmes needs to be increasingly reliant on domestic revenues, and increasing taxes can have distortionary impacts on the economy. One particular worry in a developing-country context is the potential negative impact of increasing taxes on formal sector growth and job creation. It is well known that structural change in African countries has been slow (see e.g. Newman et al. 2016), and these countries face heavy pressure to create enough good jobs for the growing population. It is a legitimate threat that increasing the tax burden of the formal sector may hinder job creation and growth.

This paper presents results from a new tax-benefit microsimulation model for Ghana (for basic information about the model, see Adu-Ababio et al. 2017), which was developed as a part of UNU-WIDER's SOUTHMOD project.[1] The model is used to simulate the impacts of expanding social protection, targeted to the poorest households with children, disabled members, or older people, on poverty, inequality, and the government budget. Results are presented for the case both where the social protection programmes are donor-funded and where they are budget neutral, i.e. financed by domestic tax increases. The basic GHAMOD microsimulation model we use, which is modelled using EUROMOD as a platform, is a static tax-benefit model.[2] However, the paper also uses quasi-experimental econometric estimates on the elasticity of formal work with respect to the tax burden on the formal sector for Ghana, based on the extensive margin estimates from a background study by McKay and Pirttilä (2017), where similar estimates are also derived for a set of other African countries. The estimates are based on a repeated cross-section approach, where

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[1] More information about the project is available at https://www.wider.unu.edu/project/southmod-simulating-tax-and-benefit-policies-development.

[2] For information about EUROMOD, which is both a tax-benefit model for European countries and software for building microsimulation models, see Sutherland and Figari (2013).

the data are divided into groups that are formed using exogenous characteristics of household members (such as their age, education, and sex) and the impact of taxes on the share of formal work is identified from group-time interactions in a model with group and time fixed effects.[3] The implied increase in the tax rate that is needed to finance the social protection policies is combined with the estimated elasticity of formal sector work, and therefore the impacts of the policy reform are calculated also taking into account behavioural responses. The formality margin is, we would argue, the main margin of interest in countries such as Ghana, where unemployment is almost non-existent and hours choice in the formal sector is not a key concern.

The paper contributes to the literature in the following ways. First, we present results from a microsimulation model for a developing country, and such literature is exceptionally scarce, with the study using Mexican data and model by Abramovsky and Phillips (2015) as a prime exception. Second, the paper uses estimates for the elasticity of formal work derived for Ghana. To the best of our knowledge, there are no earlier studies with credible identification on the elasticity of formal sector jobs using data from Africa. However, there is a series of papers demonstrating that crowding out of formal sector jobs may be a potential threat when expanding social protection in a Latin American setting: see for instance Alzúa et al. (2012), Garganta and Gasparini (2015), and Bergolo and Cruces (2014). Third, the study highlights the costs and benefits of social protection expansion in addition to presenting econometric estimates.

The study proceeds as follows. Section 2 describes the institutional setting in Ghana. Section 3 presents the data and some descriptive analyses. The methods used in the econometric part are covered by Section 4. This section also describes the microsimulation model and the policy reform. Results are presented in Section 5. Section 6 concludes.

## 2    The institutional environment

Ghana is a lower middle income country (GDP per capita around US$1500 in 2016) that is expected to return to a rapid growth path after macroeconomic turmoil in recent years. The latest household survey, which is from 2012/13, had the poverty headcount rate at 24 per cent (see for instance McKay et al. 2016). Poverty has been falling consistently for 30 years, but at the same time regional disparities have risen. The poverty line stood at approximately 1,300 Ghanaian cedi per adult equivalent

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[3]The estimator was used by Blundell et al. (1998) for the case of labour supply in the UK and applied to a cross-country case by Jäntti et al. (2015).

a year in 2013 (presently, one Ghanaian cedi equals around US$0.2). As in other African countries, poverty is based on consumption and measured on an absolute, rather than relative, basis.

## 2.1 The tax and benefit system

According to the IMF, the tax revenues stood at 18 per cent of GDP in 2016, with indirect taxes raising the largest part of the revenues. In addition to a value-added tax with a rate of 17.5 per cent (including an earmarked health insurance levy), the country operates excise taxes on alcohol, tobacco, and fuels (with a small subsidy on kerosine). The income tax is individual-based and progressive. The highest marginal income tax rate is 25 per cent. The employers' social security contribution (SSC) rate is 13 per cent of gross wage and employees are mandated to pay a 5.5 per cent social security payment. Those self-employed whose firms' turnover is in the range of 10,000–120,000 Ghanaian cedi are subject to a presumptive turnover tax with a rate of 3 per cent. This tax replaces the VAT for the affected firms.

From the social insurance instruments, Ghana only operates a defined contribution pension system for formal sector workers. Ghana is also expanding its Livelihood Empowerment Against Poverty (LEAP) cash transfer system. The transfer system is targeted to the poorest households (the bottom 20 per cent of the poor), and eligibility is determined using a proxy means test that is meant to find those at the bottom of the distribution. In addition, the recipients need to be caregivers to orphans or vulnerable children (OVCs), older persons (above 65 years of age), or disabled persons. The amounts are tied to the number of recipients in the household, and in 2013 they varied from 8 to 15 Ghanaian cedi a month. These sums were already raised the following year.

## 2.2 Formality

A key issue facing the Ghanaian economy is that the large majority of the workforce works in the informal sector. According to Alagidede et al. (2013), the formal sector share of all workers is a mere 14 per cent. Therefore the tax base for income is very narrow and increasing the number of formal jobs is a key policy concern. Ghana has experienced substantial growth in non-farm self-employment since the late 1980s, which many consider the outcome of large structural changes in the mid-1980s (see for instance Bank of Ghana 2007 and Osei-Boateng and Ampratwum 2011). Based on assessment of the 2012/13 Ghanaian Living Standards Survey (GLSS6), Statistics Ghana states that the 'inability of the formal sector to generate jobs in their required

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number has pushed many into the informal sector which is predominantly made up of small to medium-scale businesses'. Workers in the informal sector suffer from irregular employment and often perform low-quality jobs under less decent work conditions (Ghana Statistical Service 2014a).

# 3  Data and descriptive evidence

The Ghana Statistical Service (GSS) started conducting the Ghana Living Standards Survey (GLSS), a household survey, in 1987 (for more details see Ghana Statistical Service 2014b). Since then six waves have taken place (GLSS1 to GLSS6), namely in 1987, 1988, 1991/92, 1998/99, 2005/06, and 2012/13. The data are in the World Bank Living Standards Measurement Survey format, and include detailed information about individuals' background, income, and consumption. The econometric estimates are based on data from the last four rounds, GLSS3 to GLSS6,[4] and in particular GLSS6 for the microsimulation exercise.

Pinpointing the exact size of the informal sector in the GLSS data requires making several assumptions as the questionnaires have changed across time. For the purpose of this study we mainly use information on the sector to define formality. Specifically, in GLSS5 and 6 a worker is defined as formally employed if employed in the government sector or the formal private sector (including paid apprentices), by a parastatal employer, an NGO (local and international), a co-operative, or international organisations and diplomatic missions. A worker is defined as informally employed if working in the informal private sector, as a domestic employee, casual worker, or apprentice. Pensioners, unemployed, inactive, and students are considered as neither formally nor informally employed.

In GLSS4 slightly less detailed information is available on sector and status of the job and respondents cannot state that they are working in the informal private sector. We therefore consider those employed in the government sector, in the formal private sector (including paid apprentices), by a parastatal employer, an NGO (local and international), a co-operative, or international organisations and diplomatic missions as formal, as well as any self-employed in a business with employees. Farmers without employees and self-employed without employees are in turn considered as informal. In GLSS3 anyone indicating that they were self-employed or working on a farm or in an enterprise belonging to them or their household is considered as informal.

Table 1 provides basic summary statistics about the sample used in microsimu-

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[4]Comparability between the first two waves and GLSS3 and later rounds is undermined by the differences in the survey method.

Table 1: Summary statistics of persons with non-missing labour or self-employment income data by formality status in GLSS6 data set.

| | Informal | Formal | Total |
|---|---|---|---|
| Male | 0.449 | 0.659 | 0.477 |
| | (0.497) | (0.474) | (0.499) |
| Age | 37.46 | 38.51 | 37.61 |
| | (15.41) | (12.93) | (15.10) |
| No education | 0.283 | 0.0769 | 0.255 |
| | (0.450) | (0.266) | (0.436) |
| Primary education | 0.262 | 0.0949 | 0.240 |
| | (0.440) | (0.293) | (0.427) |
| Secondary education or higher | 0.455 | 0.828 | 0.506 |
| | (0.498) | (0.377) | (0.500) |
| Household size | 5.331 | 4.230 | 5.182 |
| | (3.178) | (2.659) | (3.135) |
| Farmer | 0.279 | 0.123 | 0.258 |
| | (0.449) | (0.328) | (0.438) |
| Self-employed | 0.298 | 0 | 0.258 |
| | (0.458) | (0) | (0.437) |
| Employee | 0.148 | 0.813 | 0.238 |
| | (0.355) | (0.390) | (0.426) |
| Agricultural sector | 0.500 | 0.128 | 0.449 |
| | (0.500) | (0.334) | (0.497) |
| Manufacturing sector | 0.150 | 0.172 | 0.153 |
| | (0.357) | (0.377) | (0.360) |
| Service sector | 0.350 | 0.700 | 0.397 |
| | (0.477) | (0.458) | (0.489) |
| Public sector worker | 0 | 0.417 | 0.0567 |
| | (0) | (0.493) | (0.231) |
| Urban | 0.442 | 0.758 | 0.485 |
| | (0.497) | (0.428) | (0.500) |
| Gross annual income | 2820.7 | 8158.1 | 3546.5 |
| | (13237.5) | (27022.4) | (15938.1) |
| Net annual income | 2820.7 | 7122.7 | 3405.7 |
| | (13237.5) | (21495.7) | (14710.4) |
| Observations | 32363 | | |

Notes: Standard errors in parentheses. Source: Authors' calculations based on GLSS data.

Figure 1: Share of formal sector workers out of all employed and self-employed (15 years or older).
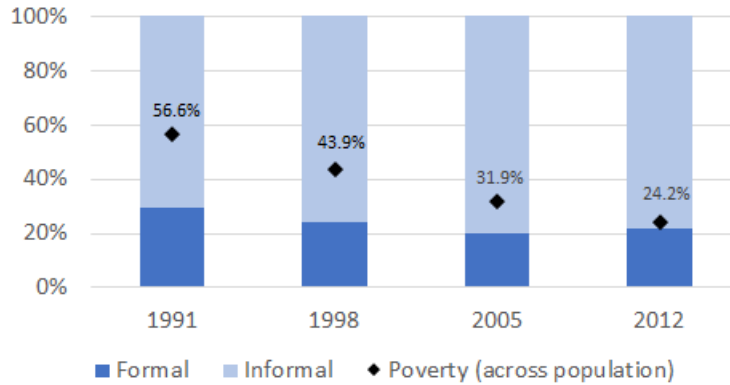
lation when calculating the impacts of tax changes (that is, observations for which labour income or self-employment income data exist are used) for 2012/13. The formal sector is, as expected, composed of better-educated individuals. While around four out of five of workers in the formal sector (83 per cent) in 2012 had attained a secondary degree or higher, this was true for less than half of workers in the informal sector (46 per cent). Formal sector workers have better education and they reside in urban areas more often than informal sector workers do. Formal sector workers are often employees and they typically work for the service sector (which includes public sector workers), whereas many informal sector workers work in the agricultural sector. Net annual income (gross income minus income tax and social security payments paid by the employee) for formal sector workers is on average more than twice the income for informal sector workers (for whom by definition gross and net wages are the same).[5]

Our data confirm the decrease of the formal sector discussed in the literature (see Figure 1). Between 1991 and 2012 the share of formal workers declined from 29.6 per cent to 21.7 per cent.

Formal sector workers enjoyed on average higher net pay across all four waves (see Figure 2). The propensity to be paid below the minimum wage (the red line

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[5]The different characteristics may mean that finding a job in the formal sector is not easy for many informal sector workers, such as agricultural workers in rural areas. We will consider the consequences of this for the microsimulation results with dynamic effects towards the end of Section 5.

in the graph) was also considerably lower in the formal sector than in the informal sector.

Figure 2: Wage distribution for formal and informal workers across time.
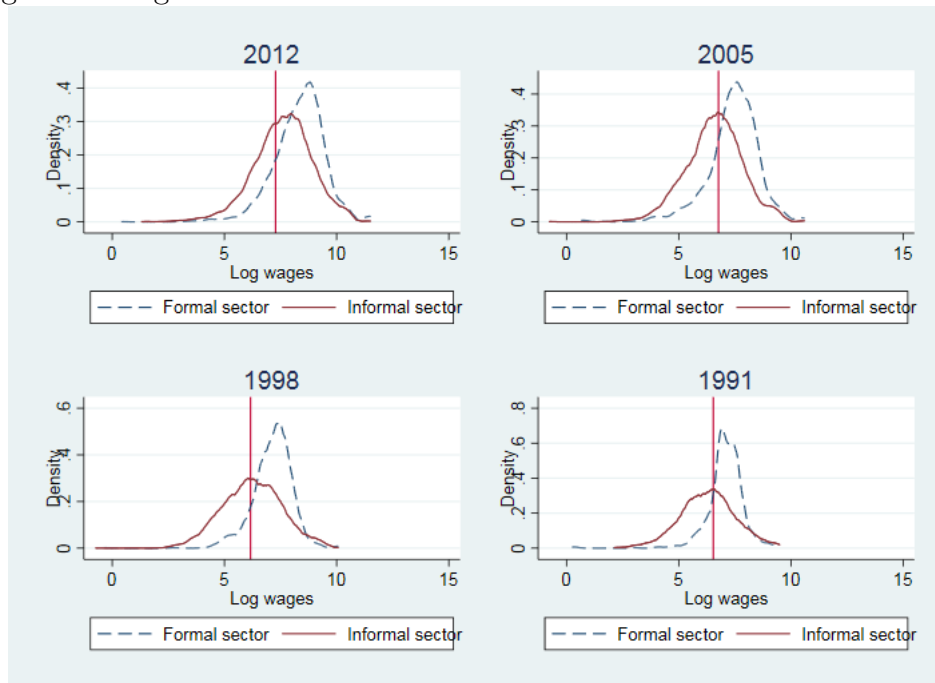


Source: Authors' calculations based on GLSS data.

# 4  Modelling approach

For the purpose of this study we combine econometric estimation methods and microsimulation methods which are explained in more detail below. The results from both methods inform each in other in the following manner: first, we estimate the elasticity of the formal sector with regard to the net pay difference between the formal and the informal sector based on four waves of the GLSS. Second, we use GHAMOD, the microsimulation model for Ghana, to simulate two different policy reforms: a stand-alone expansion of social protection and a revenue-neutral expansion of social protection financed through an increase in employee payroll tax. Next we combine the changes arising in the net pay differential between the formal and informal sector due to the policy changes with the formality elasticity estimated in the first step, to gauge the effect on the size of the formal sector. Finally, we recalibrate

the weights taking into account the changes in the size of the formal sector, before calculating the overall effects of the policy and behavioural changes on poverty and distributional outcomes and the government budget.

## 4.1 Conceptual framework

We consider the following stylized framework to form the backdrop for the econometric work. The individual can either work in the formal sector, earning income $y_f$, or in the informal sector (or in the shadow economy), earning income $y_s$. If the individual works in the formal sector, he or she pays taxes (which can include employees' social security contributions) $T(y_f)$ and obtains transfers equal to $B(y_f)$. Thus, net income in the state of formal work is given by $x_f = y_f - T(y_f) + B(y_f)$, which must be sufficient to finance consumption $c_f(1+\tau)$, where $\tau$ is the consumption tax rate. Note that payroll taxes paid by employers affect the gross salary. The labour costs to the employer, denoted by $Y_f$, are $Y_f = (1+p)y_f$, which means that the gross income already encompasses the effect of payroll taxes, as gross income can also be written as $Y_f/1+p$.

If the individual works in the informal sector, no taxes are paid, but the individual might still be entitled to some benefits, $B(y_s)$, reflecting the fact that social protection programmes in developing countries, including in Ghana, often reach those working outside of the formal sector. The net income in the state of informal work is thus $x_s = y_s + B(y_s)$, which is used for consumption $c_s(1+\tau)$. Note that here we assume that both those in the formal sector and those in the informal sector indirectly pay value-added tax. Those who do not work at all can be treated as informal sector workers, but earning zero labour income.

The individual utility is linear (or log-linear) in consumption, and utility when working in the formal sector is thus $x_f/(1+\tau) - \psi$, where $\psi$ is the cost (which can be negative) of working in the formal sector. The costs are positive if working in the formal sector requires e.g. a longer commute but the costs can also be negative, if formal sector work also brings about other benefits (such as retirement income). The utility when working in the informal sector is $x_s/(1+\tau)$. This means that the individual works in the formal sector if

$$x_f - x_s \geq \psi(1+\tau), \tag{1}$$

which also means that the commodity tax does not affect the choice between formal and informal sector work.[6]

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[6]Note also that any changes in the payroll tax that the employer needs to pay for the formal sector wage, $(1+s)y_f$, are already reflected in the gross pay, $y_f$, depending on the incidence of

Note that although this model is written as if working in the formal versus informal sector were solely based on individuals' choice, it can also be interpreted so that taxes on formal work create a wedge for formal sector employers, and the tax changes are therefore reflected in the gross wage they offer. According to conventional economic incidence analysis, a reduction in the income tax paid by workers can lead to a reduction in their asking wage, and therefore increase employment. Such a mechanism is, however, not possible, if the tax cut affects workers whose employment level is distorted by the presence of a minimum wage. For such workers, even if a tax cut would lead them to be satisfied with a lower gross wage, this would only lead to an increase in the supply of labour and not to an increase in employment (which is restricted by the minimum wage). It is for this reason that in the estimations below we mostly focus on workers who are paid wages above the legally binding minimum wage.[7] Another potential complication would arise from general equilibrium effects on wages—gross pay could be a function of the changes in the number of workers, but as in most micro-econometric tax studies such issues are assumed away in the basic set-up.

## 4.2   Estimation

In the empirical approach, explained in more detail in the Appendix, the idea is to estimate an empirical counterpart of Equation 1, i.e. the probability of working in the formal sector $P(y_f > 0)_{i,t}$ for the individual $i$ and at period $t$ is

$$P(y_f > 0)_{it} = \alpha + \beta \times [x_f - x_s]_{it} + \epsilon_{it}, \tag{2}$$

where $P(y_f > 0)$ is defined to take on the value of 1 if the individual supplies labour income in the formal sector exceeding zero. The estimation of this raises a number of challenges. One is that the key regressor on the right, $(x_f - x_s)$, is endogenous: if a person moves from the informal to the formal sector, net income changes. Second, net income is only observed for one state (informal/formal) at a time. The solution is to utilize a group-based pseudo panel approach, where the data are aggregated to groups, defined based on exogenous characteristics (such as sex, age, education), and the equation is estimated at a group level. Then, group mean values are used to get an estimate for $(x_f - x_s)$ for each individual. The approach can also be interpreted as an instrumental variables approach, where group-time interactions are used as

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payroll taxes.

[7]We acknowledge that this issue is more complicated in practice, as minimum wages are not necessarily effectively enforced: see Bhorat et al. (2015).

Table 2: Elasticity of the share of formal work with respect to the change in the net pay between formal and informal work.

| | No controls | All controls | All controls, above minimum wage |
|---|---|---|---|
| Elasticity | 0.549*** | 0.238*** | 0.388*** |
| Std error | 0.131 | 0.09 | 0.101 |
| Number of cells | 158 | 158 | 147 |

Notes: Linear probability regression results with the share of formal work as the dependent variable. The key regressor is the difference between the log of net pay in the state of formal work versus the log of net pay in the state of informal work. The model in Column 1 with no controls, the model in Column 2 with a full set of group and time dummies (groups formed based on age, sex, and education), and the model in Column 3 with the wage restricted to lie above the legal minimum wage. Instead of the regression coefficient, an elasticity estimate is shown. Standard errors calculated with the delta method. *** indicates significance at the 1 per cent level.

Source: Authors' calculations based on GLSS data.

excluded instruments for $(x_f - x_s)$ in a model with group and time fixed effect added to an equation like (2).

The results can be converted into an elasticity format, where the elasticity of the share of formal work with respect to the change in the net pay $(x_f - x_s)$, or formality elasticity for short, is defined as

$$\varepsilon = \frac{dP(y_f > 0)}{d(x_f - x_s)} / \frac{P(y_f > 0)}{(x_f - x_s)} = \beta * \frac{(x_f - x_s)}{P(y_f > 0)} \tag{3}$$

## 4.3   Data and estimation results

We use waves 3 to 6 of GLSS for the estimation. The data are divided into groups based on sex, age (five ten-year age groups for persons between 15 and 60 years of age), and four education groups [8] The data are restricted to those who are workers; i.e. the self-employed are dropped from the estimation sample.

The result for models where log of net income is used are reported in Table 2. The first column shows only the strong correlation between the share of formal work and the difference in the take-home pay between formal and informal work, the second model includes a full set of group and time dummies, and the final col-

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[8]The groups are: Not completed primary education, Primary, Lower secondary, and Upper secondary or higher.

umn is the preferred specification, where the formal sector wage is restricted to be above the minimum wage. The results from the final two models can be given a causal interpretation. They are statistically significant (at the 1 per cent level) and the estimated elasticity is not too far away from the ballpark of extensive margin elasticities estimated using high-income country data.

## 4.4    Simulation of tax-benefit reforms in Ghana

### 4.4.1    GHAMOD, a microsimulation model for Ghana

Our starting point is the static tax-benefit microsimulation model, GHAMOD (Adu-Ababio et al. 2017). The model is built on the EUROMOD platform. The underpinning data set is the latest wave of the Ghana Living Standard Measurement Survey, GLSS6 from 2012/13. The policy rules are modelled for every year from 2013 to 2016; from 2014 on, all incomes are uprated taking into account inflation, though exclusively using the Consumer Price Index due to lack of other indices. For the purpose of this study all simulations are performed for the base year, 2013, and no uprating is necessary.

The model simulates the following taxes, levies, and benefits:

- Personal income tax, which is a progressive tax on income from formal work with a top marginal tax rate of 25 per cent.

- Social security contributions are a combination of two schemes. The SSNIT (Social Security and National Insurance Trust) rate is a flat-rate tax levied on employers and employees in the formal sector and restricted to those aged 15 to 45 years. The SSNIT rate is 5.5 per cent for employees and 13 per cent for employers.

- The LEAP transfer programme, which is geared towards extremely poor households (consumption per adult equivalent of 446 cedi) that also serve as caregivers to OVCs or have a pregnant, disabled, and/or old (65 or older) member, with the benefit increasing with the number of qualified individuals in the household.

- A school feeding programme (or its monetary equivalent, as it is an in-kind transfer).

- The value-added tax.

- All excises.

Simulations of indirect taxes are based on the reported expenditures in the household data set.

### 4.4.2  Policy reform scenarios

We model two different policy scenarios: (1) a stand-alone extension of social protection and (2) a revenue-neutral scenario where the more generous social safety net introduced is fully financed through an increase in employee payroll tax. Both scenarios extend existing policies, namely the LEAP benefit and the SSNIT rate for employees.

In policy scenario (1) eligibility conditions for the LEAP transfer are relaxed and the benefits made more generous:

- The benefit amounts are raised to the level that came into effect only in 2014, more than tripling benefit amounts with the minimum benefit increasing from 8 to 32 and the maximum benefit from 15 to 53 cedi a month per household.

- The eligibility threshold is raised from consumption per adult equivalent of 446 to twice that amount, i.e. 892 cedi. This threshold is still below the poverty line.

- The amounts are further doubled for those below the initial threshold (i.e. the 446 line).

- Introduction of a universal old-age pension: those aged 65 and over who do not receive any other pension receive the same amounts as other LEAP beneficiaries.

- Instead of caregivers to OVCs, all households with under-age chidren who fall below the consumption threshold are eligible.

The different elements of reform (1) are simulated simultaneously. The order of the simulation is such that the pension reform takes place first, as it can have an impact on eligibility for some LEAP transfer recipients. Scenario (1) disregards entirely how such rather massive extension could be financed.

Scenario (2) in turn is designed to fully finance the costs accruing to the government when extending social protection: on the benefit side the same rules as under scenario (1) apply. Additionally, the SSNIT rate for employees is raised to the point that it can recoup the costs of the LEAP expansion assuming no behavioural change. The increase in the SSNIT rate necessary to offset the additional expenditure on the reformed LEAP transfer programme assuming no behavioural adjustments is eight

percentage points. The exact change in the tax rate depends, of course, on how well the baseline simulation matches the actual tax receipts reported by the government. The background study by Adu-Ababio et al. (2017) reports results from a macro validation, where the total tax revenue as predicted by GHAMOD is compared with information on actual revenues from the Ministry of Finance. The simulation of labour income tax (totalling 2.1 billion cedi), for which external information exists and whose base is close to the social security contributions base, is reasonably close to the officially stated receipts (2.4 billion).

We chose to finance the additional social protection through increasing the payroll tax as changes are easy to implement and straightforward to understand. By contrast, changes to progressive income tax rate schedules are more intricate. Clearly, financing the reform with increases in indirect taxes would also be an option. Yet in the absence of consumption data revealing whether the households use informal versus formal retailers to purchase goods, changes in indirect taxation would not have any impacts on the formality margin.

# 5 Results

The results are reported in Tables 3 and 4. In the first column, we report the baseline/status quo results for the year 2013. Poverty and inequality are measured using consumption. As the changes in the policy experiment refer to income changes, we turn these into changes in consumption possibilities. In other words, we examine how much consumption would change if all the additional income were spent. The next two columns are based on static microsimulation with no behavioural impacts. The first of these shows the impacts of expanding the social protection alone (Reform A: non-revenue-neutral scenario) and the second the impacts of a reform where the SSC paid by the employees is raised to recoup the revenue (Reform B: revenue-neutral scenario). The last column includes the results with the behavioural impacts, i.e. where the tax increase leads to a reduction in the share of formal work (revenue-neutral scenario with behavioural impacts).

The labour supply estimates reported in Table 2 suggest an elasticity of 0.39 (Column 3). When calculating the impacts of the reduction in the share of formal workers we assume that the larger number of workers in the informal sector does not change informal sector wages. While there is of course concern for more general equilibrium effects, we consider the effects of the proposed interventions on labour supply in the informal sector to be not important enough to exert downward pressure on wages in the informal sector.

In a revenue-neutral reform scenario government needs to increase the employee

Table 3: Simulation results of expanding social protection on poverty and inequality.

| | Status quo (I) | Reform A: Stand-alone extension of social protection (II) | Reform B: Revenue-neutral reform (III) | Revenue-neutral reform with behavioural impacts (IV) |
|---|---|---|---|---|
| **FGT(0)** | | | | |
| All | 24.9 | 24.1 | 24.3 | 24.3 |
| Male-headed households | 26.6 | 26.0 | 26.2 | 26.2 |
| Female-headed households | 19.7 | 18.4 | 18.5 | 18.5 |
| Households with children | 27.4 | 26.7 | 26.9 | 26.9 |
| Households with older persons | 33.7 | 29.3 | 29.3 | 29.4 |
| **FGT(1)** | | | | |
| All | 8.1 | 6.7 | 6.8 | 6.8 |
| Male-headed households | 8.8 | 7.3 | 7.5 | 7.5 |
| Female-headed households | 6.0 | 4.6 | 4.7 | 4.7 |
| Households with children | 8.9 | 7.4 | 7.5 | 7.5 |
| Households with older persons | 11.0 | 7.8 | 7.9 | 7.9 |
| **Gini** | 41.7 | 40.8 | 41.1 | 40.8 |
| **P80/P20** | 3.53 | 3.46 | 3.46 | 3.46 |

Notes: Poverty rates measured using consumption-based absolute poverty line of 1314 Ghanaian cedi per adult equivalent per year. The Gini index is also calculated on the basis of consumption. Source: Authors' calculations using GHAMOD.

SSC rate by approximately eight percentage points (from 5.5 per cent to 13.5 per cent).[9] The decrease in the difference in net wages between the formal and informal sector wage together with the elasticity estimated in Table 2 then implies that formal sector work is decreased by 2.57 per cent.

Reforming LEAP and the pension system reduces poverty overall (Column 1), and in particular among households with older persons (defined as households with at least one member above 65). While the headcount rate (FGT(0)) overall would decrease by less than one percentage point in the reform scenario, it would decrease by more than four percentage points among households with older persons. Female-headed households also benefit slightly more than male-headed households. The wide coverage of the simulated pension benefit explains why households with older persons benefit particularly. The poverty gap index (FGT(1)) is reduced relatively more, especially among households with older persons. The decrease in poverty is accompanied by a decrease in inequality as the proposed reform of the benefit system mainly benefits those at the bottom of the income distribution.

In a revenue-neutral reform scenario (Column 3 of Table 3) these effects remain largely the same: the decrease in poverty is smaller overall but still sizeable for households with older persons. Interestingly, the effects of the proposed reforms remain stable even when considering negative effects on the share of formal sector workers due to higher social security payments by employees in the formal sector (Column 4 of Table 2); the decrease in the formal labour share barely affects poverty rates as households benefiting from the increased social protection are mostly employed in the informal sector.

The proposed reforms entail significant costs to the government's budget (see Table 4). Extending coverage of LEAP increases expenditure on the LEAP programme by more than 120 times (Column 2 in Table 4). Extending coverage of the pension system to those aged 65 years and above with no pension entitlement so far implies additional expenditures of 437 million cedi. Both reforms together thus amount to a total of 710 million cedi of additional expenditure for the state budget. In a revenue-neutral setting, on the other hand, government more than doubles its income from employee SSC (from 389 to 1095 million cedi, Column 3 in Table 3) to offset the additional expenditure due to the extension of social protection.[10]

Factoring in behavioural responses of labour supply (Column 4 in Table 3) shows

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[9] Due to a rounding error, the proposed reform is not exactly revenue neutral.

[10] The reason that such a relatively costly reform leads to fairly small changes in poverty on average is explained by the fact that the total poverty gap (the number of poor persons times the mean poverty gap per person) was approximately 8.7 billion cedi, implying that complete poverty eradication would require reform of a greater order of magnitude.

Table 4: Simulation results of expanding social protection on government budget.

| | Status quo (I) | Reform A: Stand-alone extension of social protection (II) | Reform B: Revenue-neutral reform (III) | Revenue-neutral reform with behavioural impacts (IV) | Difference between (III) and (IV), in % |
|---|---|---|---|---|---|
| LEAP benefit | 3.34 | 273.50 | 273.50 | 274.3 | 0.30 |
| Old-age LEAP | 0.00 | 436.58 | 436.58 | 436.9 | 0.07 |
| Employee SSC | 388.63 | 388.63 | 1094.93 | 1057.6 | −3.41 |
| Employer SSC | 1066.54 | 1066.54 | 1066.54 | 1030.1 | −3.42 |
| Income tax | 2059.78 | 2059.78 | 2059.78 | 1989.4 | −3.42 |
| Budget effects | - | 710.08 | 3.78 | 145.8 | |
| Formal sector (%) | 13.6 | 13.6 | 13.6 | 13.1 | −3.67 |

Notes: The budgetary implications are expressed in millions of Ghanaian cedi.
Source: Authors' calculations using GHAMOD.

that the consequences of a lower share of formal sector employees for the state budget are negative but not drastically so. The government now has lower receipts of employee SSC, due to the smaller formal sector, but the decrease is overall around 3 per cent. The receipt of employer SSC and income tax is reduced by a similar amount in the scenario with behavioural responses.

## 5.1 Sensitivity analysis

The purpose of this section is to examine how sensitive the results in the analysis with behavioural impacts are with respect to some key parameter values. Equation 3 implies that the greater the change in the share of formal sector, $dP(y_f > 0)$, the higher are (i) the formality elasticity, $\varepsilon$, (ii) the relative change in the net pay, $d(x_f - x_s)/(x_f - x_s)$, and (iii) the initial size of the formal sector, $P(y_f > 0)$. The difference in the poverty and government budget implications of the reform between the static and dynamic calculation is therefore directly related to the magnitude of these three terms. Out of these, we would argue that the last, the share of the formal sector, is fairly reliably measured in the data; our estimate of its size is also close to external information from Alagidede et al. (2013). We therefore conduct sensitivity analysis with respect to the first two parameters, the elasticity and the change in the net wage.

The formality elasticity (approximately 0.39) is moderate, and therefore it is worth investigating how much the results would change if one were to use a higher elasticity estimate. We therefore repeat the calculations by assuming an elasticity equal to 0.75. We also experiment with changing the relative change in net pay (which is around $-10$ per cent in the base analysis). One could argue that using mean values of net incomes for all formal and informal sector workers could overestimate the wage difference between the two sectors, if for instance a high proportion of informal sector workers are relatively immobile rural agricultural workers with low pay. This would, in turn, underestimate the relative change in the net pay when taxes are increased. A more detailed analysis of the data reveals that the pay difference across sectors is indeed somewhat smaller in urban areas. However, the urban formal sector gross wage is also higher on average, implying that the relative change in net pay is approximately $-13$ per cent when calculated among the urban sector workers only. This reasoning led us to check the implications of using a $-15$ per cent change in the net pay in the dynamic analysis.

The results for government revenues and expenditures are reported in Table 5. According to them, the costs of the reform increase significantly, especially in the case where the elasticity is increased: the government budget has a shortfall of more than

Table 5: Sensitivy analysis of government revenues and expenditure.

| | Revenue-neutral reform with behavioural impacts | The same with greater wage change ($-0.15\%$ instead of $-0.1\%$) | The same with higher elasticity (0.75 instead of 0.39) |
|---|---|---|---|
| LEAP benefit | 274.3 | 274.9 | 275.3 |
| Old-age part of LEAP benefit | 436.9 | 437.1 | 437.3 |
| Employee SSC | 1057.6 | 1031.2 | 1012.3 |
| Employer SSC | 1030.1 | 1004.5 | 986.0 |
| Income tax revenue | 1989.4 | 1940.0 | 1904.2 |
| Change in costs vs. status quo | 145.8 | 247.9 | 321.7 |
| Share of formal workers (%) | 13.1 | 12.8 | 12.6 |

Note: The first column reproduces the numbers of Column (4) in Table 4. Source: Authors' calculations using GHAMOD.

300 million cedi instead of the 146 million cedi in the dynamic baseline calculation. The increase in the size of the net pay change has a more muted impact on the costs, but of course, the magnitude of the changes made to parameter values were much more significant when changing the elasticity.

We have also calculated the impacts of these changes to the reform on poverty and inequality (not shown for brevity). The results remain almost intact, with Gini dropping to 40.7 and the poverty impacts the same at one-digit level. Of course, if one needed to further increase the tax rates to return to a revenue-neutral scenario, the poverty rates could also increase. Despite this caveat, the main pattern of the results seems to be fairly robust: even when taking (larger) behavioural changes into account, the reform appears to reduce poverty and inequality.

# 6  Conclusion

This paper has studied, for the first time to our knowledge in a developing-country case, the impacts of expanding social protection and financing it using a tax-benefit model with behavioural elements. For the latter part, we presented estimates that

identify the causal impact of tax changes on the share of formal work in Ghana, the country we study. These estimates were then taken into account in the simulation and the overall impacts were calculated for the case both with and without behavioural changes.

The simulated policy included expanding the amounts and the eligibility threshold of the existing LEAP cash transfer programme and introducing a new universal old-age pension. The amounts offered in these reforms are still very modest and they alone would not raise the households above the poverty line. This is why their estimated impact on the poverty headcount rate was also fairly small: less than a one percentage point reduction for households with children and a four percentage point reduction for households with older people. The cost of the programme would be approximately 700 million Ghanaian cedi and financing it with an increase in the social security contribution of formal sector employees would imply raising the rate by approximately eight percentage points. The increase is sizeable, given the narrow base of the tax.

Our preferred estimate for the elasticity of the share of formal work with respect to the difference in the net pay when in formal versus when in informal work is approximately 0.39. It is statistically significant, and while it may be above the estimates from developed countries, the elasticity is not large either. This also means that the difference in the poverty-reducing impact of social protection when estimated with or without behavioural linkages is small. This finding is reinforced by the fact that poor households do not typically work in the formal sector and that is why they are not affected by the tax increase. The costs of financing the programme increase by approximately 20 per cent due to the reduction in the share of formal work.

A number of caveats need to be kept in mind when interpreting the results. First, the estimated elasticity could be larger, and we have carried out some sensitivity analysis with respect to the size of the elasticity. Second, since the data set was originally prepared to study consumption, the income data are not necessarily as reliable. One further issue is that all those working in the formal sector are modelled to pay taxes. However, while their income from their main job is subject to third-party withholding by employers, they can still evade taxes from other income they earn and, arguably, the extent of evasion may also depend on the tax rate. This means that the exact size of the tax rate increase is only estimated with some margin of error. As always in microsimulation models, we have not allowed for any "leakage" due to administrative costs or misspent revenues by the social protection administration: a point with perhaps more relevance in a poor-country context with more limited government capacity. Tackling many of these issues is on our future research agenda.

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# Appendix[11]

As already mentioned in the main text, estimating Equation (2) poses a number of challenges. First, the right-hand side regressor is correlated with $\epsilon$ and so endogenous. The most obvious reason is that both taxes and benefits are direct functions of income. An additional reason is that unobserved variables (e.g., tastes for work and savings) might affect the choice of working in the formal sector. Since the individual is only observed in at most one state at a given time, income in the other state needs to be imputed.

Our approach to tackling these issues is to utilize the repeated cross-section element of the data. This allows us to compare *groups* of individuals over time and, thereby, address these endogeneity issues by constructing instruments. Following Blundell et al. (1998), we partition the sample into group cells based on country, sex, age, and education level. The key idea behind the grouping procedure is to compare otherwise similar groups of individuals who have been affected differently by tax reforms (the difference-in-difference setting), while retaining the ambition of estimating structurally meaningful parameters, in this case the formality elasticity.

Let $g$ denote group cell. Suppose that $\epsilon_{it} = \alpha_g + \mu_t + \eta_{it}$, where $E[\eta_{it}|h_{it} > 0, g, t] = 0$. According to this assumption unobserved heterogeneity, conditional on $g$ and $t$, can be captured by a permanent group effect $\alpha_g$ and a time fixed effect $\mu_t$. This assumption can also be modified in such a way that it allows e.g. for education-group-specific linear time trends. Let $\omega_{gt}$ be a vector that contains the full set of interactions between group and time. By assumption, these are uncorrelated with $\eta_{it}$. This is the central exclusion restriction for identification. We can then estimate

$$P(y_f > 0)_{it} = \alpha + \beta \times [x_f - x_s]_{it} + \alpha_g + \mu_t + \eta_{it}, \tag{4}$$

by two-stage least squares (2SLS) while using $\omega_{gt}$ as excluded instruments for $(x_f - x_s)$. The instrument needs to have sufficient predictive power and it must affect the outcome variable only via changing the net pay variable. As the variation in the second-stage equation is entirely at the group level, Equation 4 can also be estimated by collapsing the data into time-specific group averages of the relevant variables.[12] We then estimate the parameters from

$$\overline{P(y_f > 0)_{gt}} = \alpha + \beta_{ext} \times \overline{(x_f - x_s)}_{gt} + \alpha_g + \mu_t + \eta_{it}, \tag{5}$$

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[11]This section draws heavily on the material in Jäntti et al. (2015) and McKay and Pirttilä (2017).

[12]See Angrist and Pischke (2009).

by GLS, using group size as weights. Using either Equation 4 or 5 yields identical results. Note that the estimation of the probability of working in the formal sector not only hinges on tax and benefit reforms, but is also identified from shocks affecting the gross pay in the two different states.

To deal with missing income in either of the states, we proceed using a simple and transparent approach utilizing cell means. We use the cell means $\overline{y_f - T(y_f) + B(y_f)}$ and $\overline{y_s + B(y_s)}$ to get estimates for the net income in the states of formal work and informal work, respectively. We average over individuals with and without formal earnings, respectively. Cells are, as in the regression analysis, constructed using sex, education, household type, and age. Likewise, the cell mean labour income for those whose earnings are strictly positive is used to get an estimate of the expected income for the individual when working.